

We Claim:

- 1 1. A method for synthesizing carbon nanostructures, the method comprising:
2 providing a catalyst of metal nanoparticles;
3 entraining the catalyst in an inert gas; and
4 exposing the entrained catalyst to a carbon precursor gas at a temperature sufficient to
5 form carbon nanostructures.
- 1 2. The method of claim 1, wherein the catalyst is a metal selected from the group consisting
2 of iron, nickel, molybdenum and cobalt, or mixtures thereof.
- 1 3. The method of claim 2, wherein the metal is iron.
- 1 4. The method of claim 2, wherein the metal is molybdenum.
- 1 5. The method of claim 1, wherein the catalyst has a particle size between 3 nm to 7nm or
2 about 5 nm to 10 nm.
- 1 6. The method of claim 1, wherein the catalyst is supported on a powdered oxide substrate.
- 1 7. The method of claim 6, wherein the powdered oxide substrate is selected from the group
2 consisting of Al_2O_3 , SiO_3 , MgO and zeolites.
- 1 8. The method of claim 7, wherein the powdered oxide substrate is Al_2O_3 .
- 1 9. The method of claim 7, wherein the powdered oxide substrate has a particle size of 0.5
2 μm to 5 μm .
- 1 10. The method of claim 1, wherein the inert gas is selected from the group consisting of
2 argon, helium, nitrogen, or hydrogen.
- 1 11. The method of claim 10, wherein the inert gas is argon.
- 1 12. The method of claim 1, wherein the carbon precursor gas is selected from the group
2 consisting of methane, ethane, propane, ethylene, propylene, and carbon dioxide.

- 1 13. The method of claim 12, wherein the carbon precursor gas is methane.
- 1 14. The method of claim 1, further comprising another gas.
- 1 15. The method of claim 14, wherein the other gas is selected from the group consisting of
2 hydrogen, helium, argon, neon, krypton and xenon or a mixture thereof.
- 1 16. The method of claim 15, wherein the other gas is a mixture of hydrogen and argon.
- 1 17. The method of claim 1, wherein the temperature is less than 1000 °C.
- 1 18. The method of claim 17, wherein the temperature is about 800 °C to 1000 °C.
- 1 19. The method of claim 1, wherein the carbon nanostructure is single-walled carbon
2 nanotubes.
- 1 20. A system for continuous production of carbon nanostructures, the system comprising:
2 a particle injector for entraining a catalyst in an inert gas flow;
3 a pre-heater for heating the gas flow of entrained catalyst; and
4 a reaction chamber wherein the reaction chamber comprises an inlet for the gas flow of
5 entrained catalyst, an inlet for flow of reactant gases, and inlet for creating a helical flow of gases
6 within the reaction chamber.
- 1 21. The system of claim 20, further comprising collection vessels for collecting the
2 nanostructures.
- 1 22. The system of claim 21, wherein the catalyst is a metal selected from the group consisting
2 of iron, nickel, molybdenum and cobalt, or mixtures thereof.
- 1 23. The system of claim 22, wherein the metal is iron.
- 1 24. The system of claim 22, wherein the metal is molybdenum.
- 1 25. The system of claim 20, wherein the catalyst is supported on a powdered oxide substrate.

- 1 26. The system of claim 25, wherein the powdered oxide substrate is selected from the group
2 consisting of Al_2O_3 , SiO_3 , MgO and zeolites.
- 1 27. The system of claim 26, wherein the powdered oxide substrate is Al_2O_3 .
- 1 28. The system of claim 26, wherein the powdered oxide substrate has a particle size of 0.5
2 μm to 5 μm , and the catalyst has a particle size between 1 nm to 10 nm.
- 1 29. The system of claim 20, wherein the inert gas is selected from the group consisting of
2 argon, helium, nitrogen, or hydrogen.
- 1 30. The system of claim 29, wherein the inert gas is argon.
- 1 31. The system of claim 20, wherein the reactant gas is selected from the group consisting of
2 methane, ethane, propane, ethylene, propylene, and carbon dioxide.
- 1 32. The system of claim 31, wherein the reactant gas is methane.
- 1 33. The system of claim 32, further comprising another gas selected from the group
2 consisting of hydrogen, helium, argon, neon, krypton and xenon or a mixture thereof.
- 1 34. The system of claim 33, wherein the other gas is a mixture of hydrogen and argon.
- 1 35. The system of claim 20, wherein the temperature is less than 1000 °C.
- 1 36. The system of claim 35, wherein the temperature is about 800 °C to 1000 °C.
- 1 37. The system of claim 20, wherein the carbon nanostructure is single-walled carbon
2 nanotubes.
- 1 38. A carbon nanotube structure produced by the process of :
2 entraining a catalyst in an inert gas, wherein the catalyst is a metal supported on a
3 powdered oxide substrate, wherein the metal is selected from the group consisting of iron, nickel,
4 molybdenum and cobalt, or mixtures thereof, and the powdered oxide substrate selected from the
5 group consisting of Al_2O_3 , SiO_3 , MgO and zeolites;
6 exposing the entrained catalyst to a precursor gas at a temperature sufficient to form
7 carbon nanotube structure; and

- 8 collecting the synthesized carbon nanostructures.
- 1 39. The process of claim 38, wherein the metal is iron.
- 1 40. The process of claim 38, wherein the metal is molybdenum.
- 1 41. The process of claim 38, wherein the powdered oxide substrate is Al_2O_3 .
- 1 42. The process of claim 38, wherein the powdered oxide substrate has a particle size of 0.5
2 μm to 5 μm , and the metal has a particle size between 3 nm to 10 nm.
- 1 43. The process of claim 38, wherein the inert gas is selected from the group consisting of
2 argon, helium, nitrogen, or hydrogen.
- 1 44. The process of claim 43, wherein the inert gas is argon.
- 1 45. The process of claim 38, wherein the reactant gas is selected from the group consisting of
2 methane, ethane, propane, ethylene, propylene, and carbon dioxide.
- 1 46. The process of claim 45, wherein the reactant gas is methane.
- 1 47. The process of claim 45, further comprising another gas selected from the group
2 consisting of hydrogen, helium, argon, neon, krypton and xenon or a mixture thereof.
- 1 48. The process of claim 47, wherein the other gas is a mixture of hydrogen and argon.
- 1 49. The process of claim 38, wherein the temperature is less than 1000 °C.
- 1 50. The process of claim 38, wherein the carbon nanostructure is single-walled carbon
2 nanotubes.